



SEWERS, POLLUTION, AND PUBLIC HEALTH IN PHILADELPHIA

BY ADAM LEVINE

For about 100 years, from roughly the mid-19th to the mid-20th century, Philadelphia poured raw sewage into its two major rivers, the Delaware and the Schuylkill, which also served as the sources of the city's drinking water. Fouling one's own nest is something that even a bird knows not to do. Yet, Philadelphia had good company in this seemingly irrational behavior, since many of the world's most prosperous and populous cities did exactly the same thing.

Municipal water supplies tainted with sewage led to sickness or death for literally millions of people in these cities. This health disaster was mitigated in some places (such as New York and Boston) by piping in clean water from remote places and in others (such as Philadelphia and Pittsburgh) by building filtration plants to purify polluted river water. With the water made safe to drink, disease rates dropped dramatically, but any impetus to undertake the herculean task of stemming water pollution at its myriad sources was lost.

Pollution became so severe in many places, including Philadelphia, that the rivers and lakes became dead zones, devoid of the dissolved oxygen needed to support aquatic life. Fish kills were common occurrences. Dockworkers were sickened by the fumes of hydrogen sulfide, a byproduct of the decomposition of sewage. The same fumes also tarnished the silver coins in sailors' pockets and rusted any metal buildings along the riverfronts. Many cities and industries continued to use adjacent bodies of water as sinks for their wastes until federal mandates in the 1970s, including the Clean Water Act, forced them to do otherwise.

Much of the failure to develop proper methods of sewage disposal in the 19th century can be attributed to an adherence to a mistaken theory of disease. We now understand that many diseases are caused by

microscopic bacteria, a number of which readily live in water and are easily transmitted through a polluted water supply. Before 19th-century scientists identified and isolated bacteria in various laboratories, other theories of disease held sway. The most prevalent was the "miasma," or "anticontagionist," theory, which claimed that disease was caused by bad odors, or "miasmas," arising from rotting organic matter or other filth.

According to this theory's proponents, these dangerous and deleterious odors could emanate from a variety of sources. The stench of coffee beans rotting on a wharf was one mistaken explanation for a 1793 yellow fever epidemic in Philadelphia that killed thousands of people; mosquitoes were the actual vector of transmission. The odor of naturally rotting organic matter in low-lying swamplands was also suspected of causing disease, which was one justification for draining and filling thousands of acres of tidal marshland in the city.

Human wastes were a ubiquitous source of miasmas, especially in densely populated urban centers. Before the introduction of the water closet, or flush toilet, human wastes were collected in privy pits, commonly located beneath backyard "outhouses." These brick-lined pits usually had open bottoms that allowed the liquid components of wastes to drain into

Philadelphia's Historic Streams



(LEFT) Map of Philadelphia's streams before they were covered over for sewers.

Courtesy of the Philadelphia Water Department Historical Collection.

(BELOW) Fairmount Water Works, c. 1840, watercolor by George Lehman.



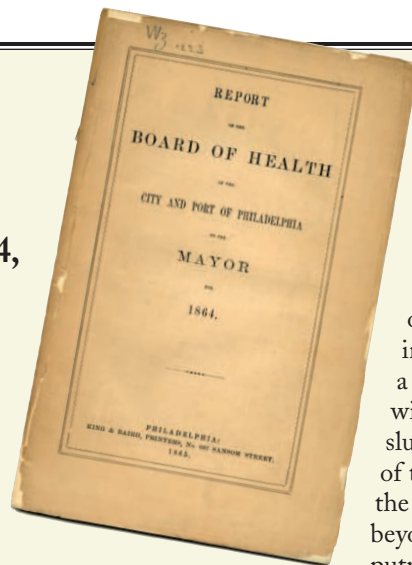
the surrounding soil. Even so, privies would gradually fill up and needed to be emptied periodically, a task regulated in 19th-century Philadelphia by the Board of Health. The board investigated complaints of foul-smelling or overflowing privies, requiring homeowners to empty them and fining those who refused to comply. They also licensed the privy cleaners, who often performed their nasty work at night when most residents were inside and thus less susceptible to the malodorous miasmas that such cleanings inevitably stirred up. The nocturnal nature of the work led to the creation of a nickname—"night men"—for those engaged in it and a common euphemism—"night soil"—for the material they handled.

In the first half of the 19th century, Philadelphia maintained several "poudrette pits" on the outskirts of the city into which the night men would dump casks of night soil they excavated from the privies. In these pits the wastes were mixed with charcoal and swamp muck, gypsum, or other materials that absorbed excess liquid and odors and encouraged their decomposition. The resulting "poudrette" (from the French for "powder") was considered an agricultural fertilizer, and Board of Health records from this period indicate a number of sales of this human-based manure to farmers. After the Civil War, these wastes were generally disposed of in a simpler manner by diluting them with water and applying them directly to farmland or market gardens that still existed in rural areas of the city.

According to an 1886 U.S. Census report, Philadelphia issued about 9,000 privy cleaning permits in 1880, when about 20 licensed cleaners removed roughly 27,000 tons of waste. This figure included an estimated 22,000 tons of actual human "excreta" and, according to the report, "5,000 tons consisting largely of coal ashes and cinders, brickbats, broken dishes and glass, bottles, kitchen-utensils, boots, shoes, tin cans, cast-off wearing apparel, and, in fact, every imaginable thing which servants and others find it more convenient to hide in the privy-vault than to expose in the ash-barrel or to throw into the streets."

As flush toilets became more popular after the Civil War, they were often connected to the household privy pit, which overtaxed the privy system. The toilets used several gallons of water per flush, while privies were designed to accommodate only directly deposited wastes containing far less fluid. Privies filled up more quickly and overflowed more often. The need for an alternative waste disposal system soon became clear. The common solution, used in Philadelphia and many other cities, was to connect households and businesses with underground sewers that quickly drained wastes from populated areas and dumped them in the nearest body of water. In Philadelphia, the receptacles of these wastes included not only the city's drinking-water sources, the Delaware and Schuylkill, but also many smaller streams that were tributaries of those two rivers.

Report of the Sanitary Committee of the Philadelphia Board of Health, approved April 4, 1865, on a proposed ordinance “to promote public cleanliness,”
in Report of the Board of Health of the City and Port of Philadelphia to the Mayor for the Year 1864 (Philadelphia, 1865), excerpt.



The Sanitary Committee to whom was referred an amended bill submitted to Councils, entitled “An Ordinance to promote public cleanliness,” beg to report, that they . . . give their hearty approval to so much of the plan for the sanitary improvement of the city, as proposes to abandon the system of connecting privy wells with sewers . . .

Your Committee however regret that they find themselves under the necessity of objecting altogether to continuing to citizens “the privilege of connecting properly constructed water closets or water privies with sewers.”

The entire plan will, if continued, become a monstrous nuisance. Even under the best regulated system of sewerage, such a plan could not fail to be fraught with numerous sanitary evils . . . without having received that critical and plenary examination which the “grave import of the question” so richly merits. . . .

If our present system of cesspools is . . . “an abomination and a nuisance,” . . . the continuance of the ordinance, granting permits to connect water closets with sewers . . . will constitute, and more certainly in the future, . . . an abomination and a nuisance, ten-fold more dangerous to the health and comfort of the citizens than the present cesspool system. The danger we apprehend does not depend so much on imperfectly constructed drains from water closets and water privies, as on the accumulation of the solid and liquid ejecta of the population, in the sewers themselves, and the exposure it is subject to at every ebb tide, both in the Delaware and Schuylkill, as it escapes from the sewer outfalls. . . .

One of the most serious evils connected with our present plan of sewerage is the ever accumulating amount of its offensive solid contents. This collection, derived from the fluid and semi-fluid refuse of almost every department of industry that can be enumerated, . . . undergoes putrefactive decomposition, and, hence, becomes the source of the virulent and toxicological emanations escaping into the atmosphere . . .

The danger from these poisonous gases in this city has been . . . fearfully experienced during the advent of the various epidemics of yellow fever which have usually made their first appearance in the immediate vicinity of the terminus of the sewers on the river front, and from these nuclei scattering desolation and death in every direction. . . .

Setting aside the plausible objections already alluded to, . . . our City is not advantageously located topographically, to be improved in a sanitary aspect by encouraging and perfecting a system of connecting water-closets and water privy drains with our sewers. The great difficulty lies in the fact, that two sluggish rivers creep along the eastern and western boundaries of the present densely populous and business portions of it; and the tidal currents unable to bear away the sedimentary matters beyond the power of the returning waters, this half-dissolved putrescent material, with the foul additions gathered in their laggard course from the rivers themselves and the adjacent shores, is brought back and conveyed by eddies into the docks and on the neighboring banks, only to rankle and ferment at the reflux of every tide, when it is exposed, contaminating the surrounding atmosphere with its offensive and pestiferous effluvia, which has ever been a well recognized cause for the nourishment and spread of epidemic diseases.

Besides this natural disadvantage, . . . we may safely refer also to the defective construction of our old sewers . . . as regards their inclination, size, shape, and uniformity of level, together with the present limited supply of water power for flushing the sewers . . .

The proper disposal of sewage, and the excreta of the population of a large city, are questions as yet unsettled. . . .

The feeling is becoming very general, that wherever practicable, sewage should not be allowed to pollute water-courses of any kind . . .

Impressed with the paramount necessity for judicious municipal legislation in all instances where public hygiene is involved, your committee . . . offer their objections to a continuance of the system of making connection with sewers as relates to water closets and water privies. They are sensible, however, that the whole subject is far too comprehensive in its bearings on public health to be embraced in this report, and far too grave for hasty legislation.

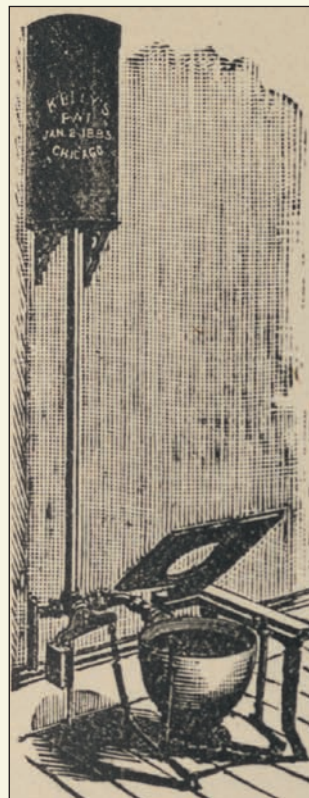
They therefore hope that Councils, in their wisdom, will still continue to hold the entire subject in abeyance, until further and more definite information can be secured. . . .

In conclusion, your committee would offer the following resolution:

Resolved, That the above report with the recommendations, be adopted.

All of which is respectfully submitted.

(Signed),
 WILSON JEWELL, M.D.,
 RENE LA ROCHE, M.D.,
 JACOB COATES,
 ELIAB WARD, M.D.,
 PETER ARMBRUSTER,
Sanitary Committee



Water-closet, from advertisement in *Plumbing Problems; or, Questions, Answers, and Descriptions Relating to House-Drainage and Plumbing for the Sanitary Engineer* (New York, 1885).

From 35 miles of sewers in 1855, the Philadelphia sewer system had expanded to more than 1,000 miles by 1900. By then these sewers were emptying untreated wastes into the rivers and their tributaries at more than 100 discharge points . . .

From a miasmist's point of view, this solution seemed entirely reasonable: it got the dangerous, disease-causing stink out from under people's noses, out of densely built neighborhoods, and into the rivers. If the theory had been right, public health would have improved. In reality, however, such a system of sewers, coupled with municipal drinking-water plants, proved to be an efficient delivery mechanism for bacteria and other disease-causing organisms. From the intestines of the sick, microbes were flushed into the sewers, dumped into the rivers, and then drawn into the reservoirs at the various pumping stations. To complete the deadly cycle, they were distributed in water pipes to households and businesses throughout the city.

From 35 miles of sewers in 1855, the Philadelphia sewer system had expanded to more than 1,000 miles by 1900. By then these sewers were emptying untreated wastes into the rivers and their tributaries at more than 100 discharge points, the largest of which was a pipe 20 feet in diameter. Between 1860, when the Board of Health began publishing detailed tabulations of causes of death, and 1909, when a city-built filtration system finally managed to supply the entire city with safe water, more than 27,000 people died of typhoid fever, the most prevalent of several deadly waterborne diseases carried in the drinking water. For each death, 10 to 15 others became ill, meaning that this disease ultimately affected hundreds of thousands of people in Philadelphia alone.

Besides facilitating the widespread pollution of the city's rivers and streams, constructing this type of sewer system required a drastic remaking of the urban landscape. As urbanization expanded into undeveloped, rural sections of the city after the Civil War, the engineers who laid out these new neighborhoods decided to drain

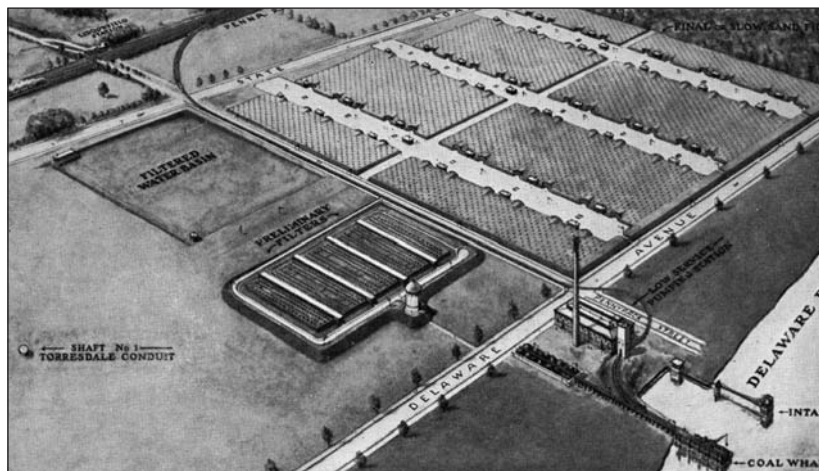
these areas by placing sewers in stream beds. The sewers carried the stream flow, any stormwater runoff from streets, and sewage from homes and businesses in a single large pipe. The engineers were not building sewers alongside the streams; they were subsuming the streams in their entirety into the city's sewer system. Such a flagrant manipulation of nature for man's purposes may seem unthinkable today, but it was standard practice in many cities well into the 20th century.

A number of practical reasons made the building of sewers in stream beds almost irresistibly appealing to municipal engineers. Sewage is 99.99 percent water, and like water, it flows most cheaply and efficiently when gravity does the work. The streams, of course, already flowed downward into either the Schuylkill or Delaware rivers. In addition, the moving water had already done much of the excavation work, having carved channels out of the landscape over eons—something that would have cost the city millions of dollars to do.

As engineers completed sewers and diverted the streams into them, they filled in the land over the pipes, sometimes 40 feet or more over the original stream bed. Once the fill had settled, the urban street grid could be extended across the valleys without the former expense of building a bridge at every stream crossing. The city installed water mains and gas mains under the streets, giving owners of the real estate through which the streams had run a ready-made infrastructure for any new houses they built. Other than a small fee collected from adjacent property owners, the city paid for the majority of this sewer work. These expenditures were easily justified by the increased revenues that came from the transformation of barely taxed rural land into densely built urban neighborhoods.

About 200 miles of Philadelphia streams were subsumed in this way. Mill Creek once drained much of West Philadelphia, with its main branch running southeast from the aptly named Overbrook train station for five miles to the Schuylkill near 43rd Street. Sandy Run had its source near Fox Chase and ran for several miles; today only a small open section of the creek remains near its confluence with Pennypack Creek. Midvale Avenue in East Falls, Winston Road in Chestnut Hill, and Leverington Street in Manayunk all follow the former courses of small, unnamed streams. Thomas Run emptied into Cobb's Creek, Wissinoming Creek and Gunner's Run into the Delaware, Rock Run into Tacony Creek, and Little Tacony Creek into Frankford Creek. All now have gone underground and appear only on the city's sewer plats.

For anyone who has ever been confused by the truncated creek that, on modern maps, changes names from Tacony Creek to Frankford Creek for no apparent reason, the missing piece of the puzzle is the



Torresdale Filter Station, in Philadelphia Bureau of Water, *Description of the Filtration Works and Pumping Station. Also Brief History of the Water Supply* (Philadelphia, 1909).

